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THE MIAMI CONSERVANCY BULLETIN

FEBRUARY, 1921

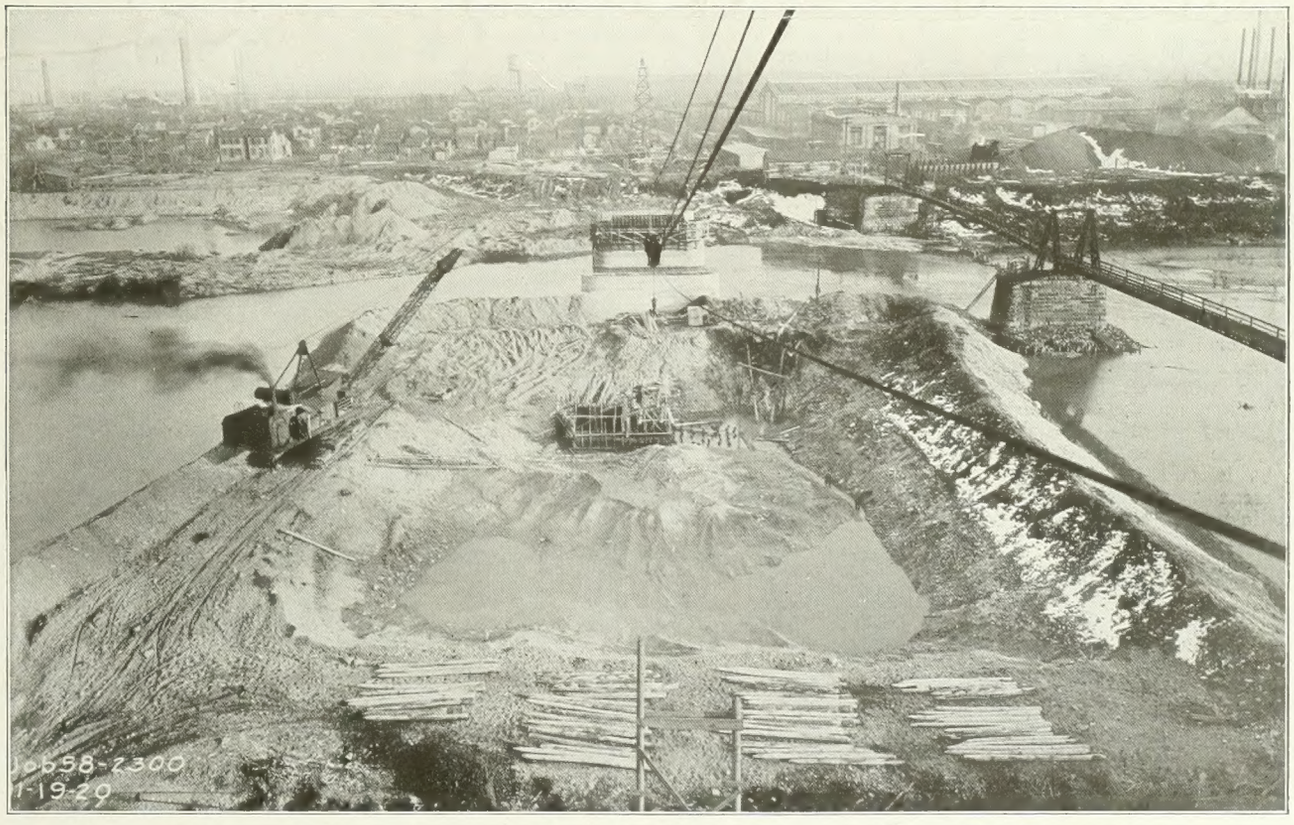

FIG. 259—EXCAVATION FOR PIERS 5 AND 6, BLACK STREET BRIDGE, NOV. 19, 1920.

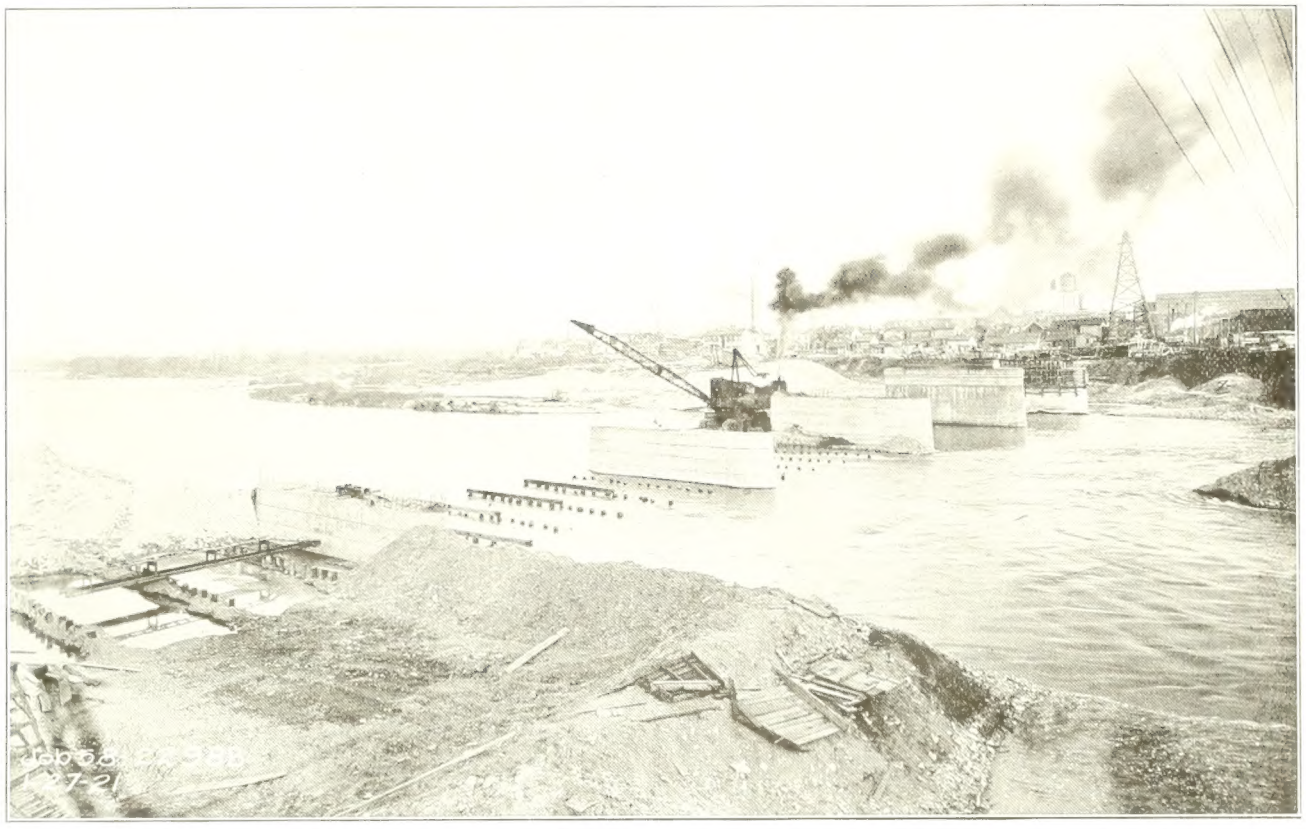

FIG. 260—BLACK STREET BRIDGE CONSTRUCTION, FROM WEST BANK DOWNSTREAM. JAN. 27, 1921.

Piers 6, 5, 4, 3, and 2 are seen in the order named, from left to right. Compare Fig. 259, taken at an earlier date, where the piling and part of the forms for pier 5 are seen in the excavation, with a pool of water in the foreground occupying the site of pier 6. Compare also Fig. 269, which shows the same view as is here seen, taken from the west tower of the cableway on the same date. The east tower of the cableway is here seen at the right in the background. The piles driven between the piers are to support the falsework for the bridge arches, which will be built during the coming season. Both abutments and 5 piers have been now nearly completed, leaving pier 1, (beyond the farthest seen) still to be built.

Compare Figure 260, showing the machine on the same day and in the same situation. The caterpillar dragline excavator has completed its work of excavation at the west end of the bridge and is crossing the river on its way back to the east bank, building as it goes an embankment to travel on, by picking up the gravel behind and placing it in front. The carriage of the cableway which handles the concrete for the piers, is seen above the dragline boom, with a suspended concrete bucket. The machine at the left is a centrifugal pump awaiting removal.

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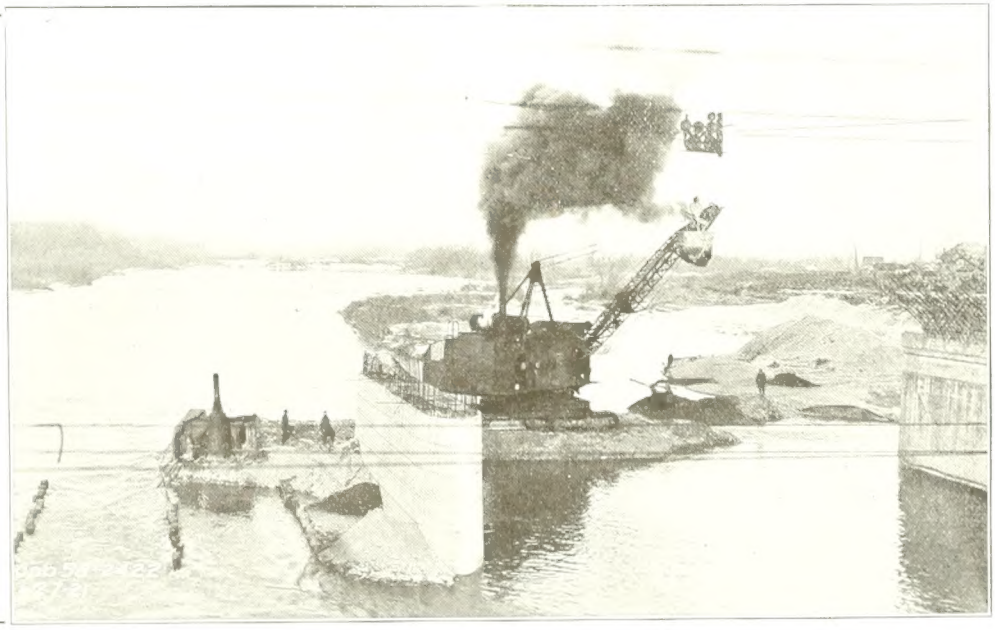

FIG. 261—DRAGLINE EXCAVATOR "TREKKING" BACK TO WORK ON PIER 1, BLACK ST. BRIDGE. JANUARY 27, 1921.

The piles next it have been driven to support the falsework for building the bridge arches, this work being planned for the coming season.

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THE
MIAMI CONSERVANCY BULLETIN
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Subscription to the Bulletin is 50 cents per year. At news stands 5 cents per copy. Business letters should be sent to Office Engineer, Miami Conservancy District, Dayton, Ohio. Matter for publication should be sent to Bulletin Office, Miami Conservancy District, Dayton, Ohio.

G. L. TEEPLE, Assistant Engineer, EDITOR.

Resignation of R. M. Riegel

The Bulletin records with much regret the resignation of Mr. Ross M. Riegel, the chief designing engineer of the District, who goes to accept a position on the engineering staff of the West Penn Railways Co. at Pittsburgh. Mr. Riegel came to the work of the District in August, 1915, and has been on the engineering staff ever since, except for a time in 1918-19, when he was with the Emergency Fleet Corporation, Housing Division, on war work. His experience includes also work on Mississippi River improvement, with the New York Board of Water Supply and with the Pennsylvania Water Supply Commission. He won the Fuertes gold medal in 1918, awarded by Cornell University, for original research on the hydraulic jump. He was appointed designing engineer of the District in 1919, following the resignation of Mr. W. M. Smith, to take charge of design on the Illinois Canal Link. His colleagues all wish him the largest measure of success.

Partial Failure of the Third Street Bridge, Dayton

On January 20, at about half past five p. m., there was a partial failure of the second pier from the south end of Third Street bridge across the Miami in Dayton, the north part of the pier cracking away from the rest and sinking about a foot, thus permitting the adjacent portions of the arches to collapse and fall into the river.

Traffic was of course at once stopped until an examination of the bridge could be made as to the cause of the accident, and proper steps taken to provide a remedy. On consultation between the city and Conservancy authorities, it was decided to call in Mr. John L. Harrington, of the firm of Harrington, Howard and Ash, bridge engineers, of Kansas City, Mo., to take charge of an independent investigation. This examination has been made, and Mr. Harrington is now engaged in preparing his report, with recommendations as to the restoration of the bridge, and as to what precautions should be taken, if any, as regards the other bridge structures. A sketch showing the part of the bridge which failed, and also some other bridge structures in the Conservancy District, including Black Street bridge in Hamilton, now building by the Conservancy forces, will be found on page 100. The importance of properly designed piers is obvious from the sketch.

Conservancy Technical Reports

In connection with the publication of Part VII of the Conservancy Technical Reports, noted last month, it is thought desirable to print in this issue a full list of these reports, with prices, etc., for the information of the public. The prices are all net, postpaid; the reports all in paper covers, 6″ x 9″.

Part I—The Miami Valley and the 1913 Flood.
By Arthur E. Morgan, Chief Engineer.
Price, 50 cents.

Part II—History of the Miami Flood Control Project. By C. A. Bock, Division Engineer.
Price, 50 cents.

Part III—Hydraulic Jump and Backwater Curves.
By Sherman M. Woodward, R. M. Riegel and J. C. Beebe. Price, 50 cents.

(Continued on Page 111)

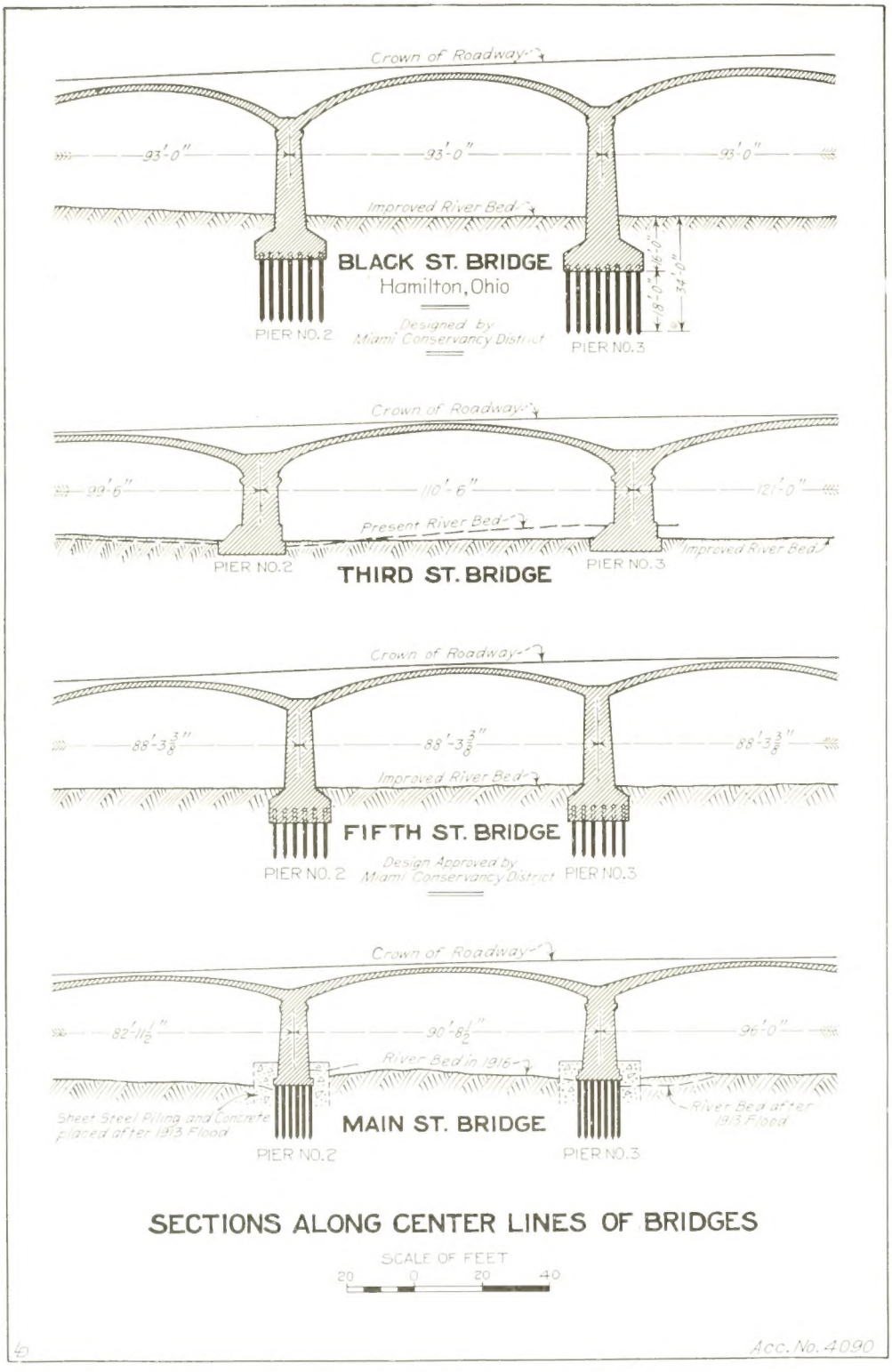

FIG. 262—SHOWING FOUNDATION CONDITION OF FOUR MIAMI VALLEY BRIDGES

Piers 2 and 3 of each bridge are exhibited, pier 2 of Third Street bridge, Dayton, being the one whose recent partial failure makes the above sketch a timely one for comparison. Black Street bridge at Hamilton, now under construction by the forces of the Conservancy District, is shown at the top, with the Third Street structure immediately below. The fundamental fault with the design of the Third Street bridge piers, according to Mr. John H. Harrington, the bridge engineer, called in to make an independent investigation of the defective structure, was that the piers were not carried to a sufficient depth and that no piles were driven under them. The ample provision at the Black Street bridge, designed and now building by the District forces, is evident as to both these particulars. (See also page 101.)

The Design of Conservancy Bridge Foundations

Piers Carried Down 12 to 16 Feet Into Gravel Material, With Piling Beneath Driven 18 Feet Deeper.

The partial failure of the second pier of the Third Street bridge in Dayton naturally directs public attention to the bridges which are on the building program under the direction of the Conservancy District; and especially to the bridge now under construction at Black Street, Hamilton, since it is a structure of the same type, and of about the same size, as the Dayton bridge which proved defective. The nature of the foundation materials and the character of the river, are also practically the same in the two cases.

It should be understood at the outset that bridge foundations in the Miami Valley cannot usually be carried down to rock. The valley was scoured out by glaciers and the valley floor is underlaid hundreds of feet deep with gravels, sands and clays deposited at the time of the great ice sheet. To go down to rock through these deposits is out of the question. Gravel mixed with sand, when excavated to a sufficient depth so that the concrete of the pier footing, when built upon it, will not be undermined by the river during flood, makes a solid and sufficient foundation. To make the assurance as to undermining more sure, however, round timber "piles," like telegraph poles, should be driven into the gravel beneath the pier footing. And there should be enough of these piles so that, even if all the gravel immediately underlying the pier should be washed away, the pier would still stand firm, supported by the piles alone. Such timber piles, it needs to be said, when below ground water level, (as in a river bed) will last indefinitely without decay.

As to both these criticisms, the facts are well brought out in Fig. 262, which shows piers 2 and 3 in each of four Miami River bridges, all drawn to the same scale, the new Black Street bridge at Hamilton being at the top; and the Third Street, Fifth Street and Main Street bridges in Dayton following in order down the page. Main Street bridge was built in 1902, Third Street in 1903, Fifth Street in 1916, while the Black Street bridge is now under construction. Inspection will show that the Third Street design, which failed, is the shallowest of the four, and also the only one which has no piles under its foundations.

The effect of the 1913 flood on Miami River bridge design is naturally very noticeable. The figure shows this, as does the record of all the Dayton bridges. Only one bridge in Dayton built before the flood has piling under its piers, and that is Main Street bridge, shown in Fig. 262. All the bridges built subsequent to the flood—Keowee Street, Webster Street, Fifth Street and the Dayton Union railway bridge—have piling beneath the piers, except the last, and in this case the concrete is itself carried to so great a depth —(26 feet below the river bed)— that piling would be superfluous.

The clearest example of the value of piling beneath bridge piers was given at the Main Street structure in Dayton during the 1913 flood. These piers, built in 1902, were not carried a sufficient distance below the stream bed, so that the flood undermined them to depths varying from 5 to 7 feet beneath considerable portions of the foundation footings, leaving

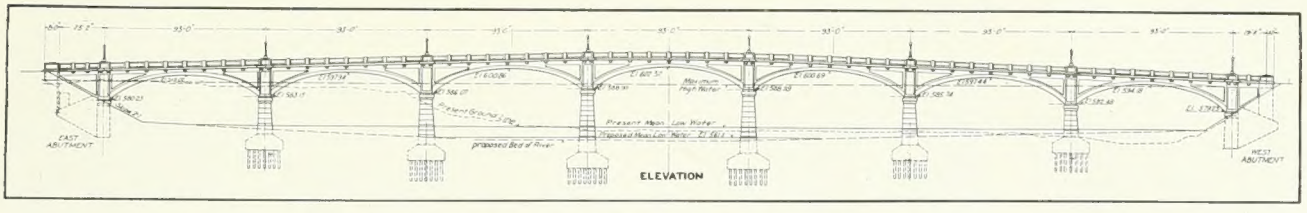

FIG. 263—ELEVATION OF BLACK STREET BRIDGE SHOWING FOUNDATIONS.

Foundations built of gravel, carried to a sufficient depth, and supported below in addition upon piles driven into the river bed in the manner described are very satisfactory. Such foundations have been provided for the Black Street bridge in Hamilton, now under construction; such also will be designed for the new Adams Street bridge in Troy, the work on both of these bridges being in charge of the Conservancy forces. Similar foundations are exemplified by the piers built for the Fifth Street, Webster Street, and Keowee Street bridges in Dayton, all of which were approved in plan by the Conservancy engineers before the structures were built.

Mr. Harrington, the consulting engineer who was called in by the city authorities of Dayton to examine and report on the cause of the trouble at Third Street, declared the fundamental cause to be faulty design in failing to carry the piers to a sufficient depth, and in failing also to provide piling beneath the concrete foundation "footings."

these portions supported by the piling alone. Undoubtedly the piling saved the structure, which in fact stood quite undamaged. The piers, under recommendation of the Conservancy authorities, were reinforced by driving a 10-foot fence of steel sheet piling around each pier, and filling the space between the piling and the pier with mass concrete. This provides a strong defensive armor against such an accident as overtook the Third Street bridge, in addition to the piling beneath the piers.

Examination of the Black Street piers in Fig. 262, will show that the concrete "footing" extends from 12 to 16 feet below the bottom of the new bed of the river as established by the flood prevention plans; and that beneath each pier the timber piles extend 18 feet below the pier bottom. The tops of the piles are imbedded two feet in the concrete of the pier. An idea of how thickly these piles are driven is given in Fig. 265, which shows the piles in the process of being driven by a steam pile driver. (The pile

driver is carried in the vertical "leads," (guides) suspended from the end of the slanting boom of the dragline excavator, the latter machine having been adapted to this use by removal of its bucket and a few other minor changes). Fig. 266 shows a test made on one of these piles after it was driven, in order to see what weight it would support. Thirty tons of pig iron were piled on a timber platform braced on top of the pile. The top of this platform during 3 days settled ¾ inch in reaching a full bearing below, after which there was no further measurable settlement during the week which the test continued. There are from 130 to 150 of these piles under each pier, the number depending on the size of the "footing," the piles being three feet apart each way. The test then corresponded to a load of 3⅓ tons per square foot of pier bottom, supported by the piles alone, supposing the gravel immediately beneath the pier top entirely washed away. This is more than would be brought by a string of loaded street cars extending end to end entirely across the bridge. Foundations under the larger buildings of Dayton, on gravel material, with timber piling, are calculated to carry from five to six tons per square foot, with an ample factor of safety. The adequacy of the Black Street pier foundations, considering these figures, will be seen to be well assured.

Earth Cofferdams for Hamilton Bridge Piers

Piers Built in Open Excavations Enclosed by Levees, Without Sheet Piling.
Dragline Substituted for Clamshell.

Excavation in the open for pier foundations, as at Hamilton, by means of a dragline excavator, appears to be an unusual procedure. (See Bulletin for August, 1920). For this reason, and because in practice it has proved so advantageous in a number of respects, a more extended notice of it is thought to be worth while.

It is imperative that bridge foundations be carried down till perfectly stable and solid material is reached, sufficient, with the aid of piles where necessary, to provide a safe support for the bridge structure, and to eliminate danger of scour. This often means excavation to considerable depths. The most obvious difficulty in making the excavation is that the foundation site is under water. This difficulty is overcome by enclosing the site with a sufficiently tight wall of some material, and pumping the water out.

This wall may be either a "caisson," or a "cofferdam." A caisson is simply a box with an open top and bottom, which is towed into position over the pier site, loaded with weights (rock or pig iron), and sunk to the river bottom, with its top projecting above the surface. The box is then pumped out, and the river bottom within it excavated, the box sinking little by little as the material is dug from under its sides. Water leaking into the excavation under the box edges and through the earth of the bottom (always more or less porous), is led to a "sump" or hollow in the bottom, and pumped out.

The pump is direct connected to an electric motor in the little house. The suction pipe is seen sloping down into the water of the excavation, A pulley hung from the timber tripod seen at the pool, enables the lower end of the suction to be lifted clear of the water to clean it in case of clogging. The horizontal pipe (the discharge), was laid of course in the open, being covered later by the dragline in building the earth levee of the cofferdam. The dragline machine (see Fig. 261), dug the hole, and piled the excavated earth around the edge, forming thus an earth "cofferdam," just as a child might dig a hole at the edge of a park pond, with a toy shovel, and pile the sand around the hole he had dug. The two processes are in ef-

(Continued below)

FIG. 264—PUMP "UNWATERING" ABUTMENT EXCAVATION, BLACK STREET BRIDGE, JUNE 10, 1920

fect precisely the same. The pump was then set up and the excavation "unwatered." The nature of the river gravel of all the pier excavations was much like that here seen.

The pile driver can be seen hung between the "leads" (vertical timber guides), the latter being suspended from the end of the slanting boom of the dragline excavator by a wire cable lashing. The hoist cable of the dragline can be seen between the two timbers of the leads, and passing to the top of the pile driver cylinder. The pile driver frame and hammer are attached to the cylinder, the entire mechanism can thus be raised and lowered in the leads by the hoist engine of the dragline. Steam is supplied to the pile driver cylinder by the rubber hose seen passing in a

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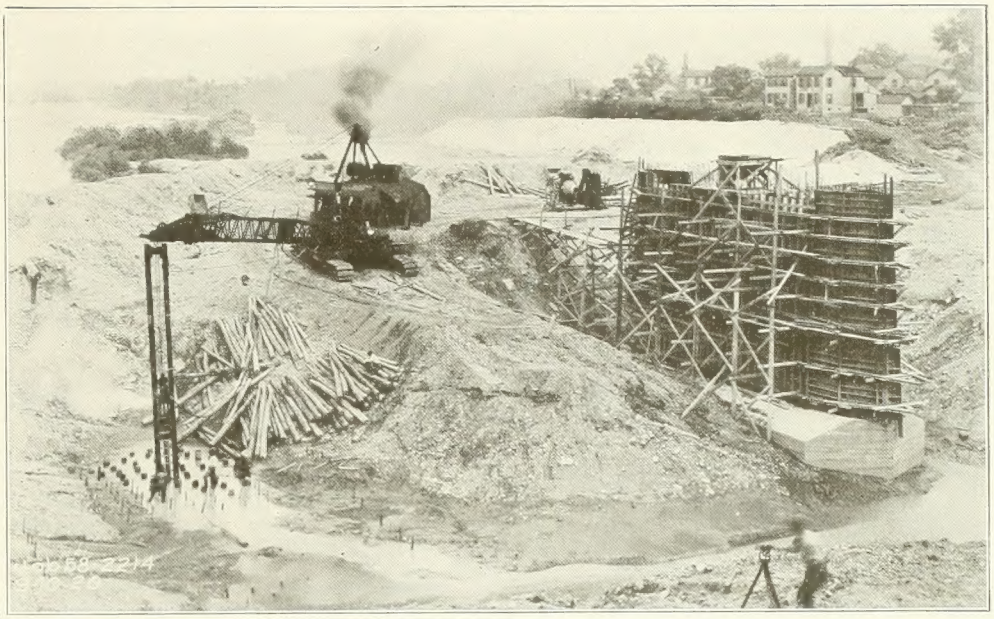

FIG. 265—DRIVING PILES FOR BLACK ST. BRIDGE PIERS SEPT. 10, 1920

loop from the pile driver to about the center of the dragline boom, whence it passes to the dragline boiler. The heads of several driven piles can be seen projecting from the pool of water at the foot of the leads, and beyond these appears a heap of piles ready to be driven. To drive a fresh pile, the leads are raised bodily, carrying the piledriver with them, this being done by pulling on the "boom fall," (the wire cable seen running back from the boom end to the top of the frame above the dragline, whence it passes down to a hoist engine). The suspended leads are then swung to the proper position for the pile to be driven, by swinging the dragline boom, the "spotting" being assisted by running the whole machine backwards or forwards on its caterpillar traction, (the latter operating like the tanks in the late war). The leads are then lowered by slacking on the boomfall, bringing the weight of the boom to bear and forcing the foot of the leads about two feet into the gravel. The leads are thus firmly held at the top and bottom and need no guy wires. The load cable of the dragline, (which for this work is passed through a pulley lashed to the boom end) is then attached to a loose pile by means of a hook, and the pile hoisted into place between the leads. The pile driver is then lowered upon the top of the pile, steam admitted to the cylinder, and the driving begins, the pile driver resting on the pile top during this process (as a wood pecker hammers a telegraph pole while standing on top of it, except that the woodpecker is cutting instead of driving). A finished pier "footing" can be seen at the right, surmounted by the form for the pier shaft. A similar footing will rest on the top of the piles which are being driven.

The caisson may be replaced by a "cofferdam." This may be a tight fence of wooden planks ("sheet piling,") driven side by side, edge to edge, into the river bottom, enclosing the pier site. Flat steel bars of "interlocking steel sheet piling" are often substituted, especially for greater depths, the edges of the bars so shaped that the adjacent piles interlock, making a fence much tighter and stronger.

When the water level within such a cofferdam has been lowered considerably by the pumps, the water without it exerts a heavy pressure tending to crush in the sides. This must be resisted, usually by placing horizontal struts of steel or timber across the enclosure, bearing against the sides, to act as braces. A network of such timbers, running lengthwise and crosswise, thus obstructs the enclosure.

The excavating is usually done by a "clamshell" bucket, raised and lowered into and out of the excavation by a steam derrick. The two halves of the bucket open on hinges (hence the name "clamshell"), and drop wide open into the material at the bottom, then close while the bucket is lifted; something as one would scoop up a double handful of mud.

The clamshell is somewhat slow and laborious in operation when working in a cofferdam like that described. It has a pernicious trick when loading, especially in gravelly material, of biting the bucket teeth every now and then on a large cobblestone, so that the jaws cannot close. Thus when the bucket is lifted—mouth down as it must be with a clamshell—the finer material all runs out and the machine must go back and load up again. In cemented material there is also often failure to load, due to the teeth sliding over the material instead of biting in. In a sheet piling cofferdam, on account of the obstructing criss-cross of braces, the bucket must first be lifted entirely clear of the piling; then swung aside to be dumped; then swung back again; then lowered for the next load. In the open the swinging and lifting, or swinging and lowering, can be done simultaneously. Care must be exercised also in "spotting" the bucket for the raising and lowering, to avoid knocking the braces down. These various difficulties consume time; and time is money.

All the troubles enumerated were avoided at Hamilton by substituting for the sheet piling cofferdam an open cofferdam of earth, which needs no obstructing cross braces, and by substituting a dragline bucket for the clamshell. The material from the excavation was taken out by the dragline bucket, and built into a rectangular levee enclosing the pier site. This excavation could be done under water, whereas a sheet piling cofferdam must be kept dry during the excavation by pumping, to permit the placing of the braces. The cost of the braces was also saved, together with the time and labor lost in placing them. The substituted process, theoretically, is as simple as when a child digs a water hole at the edge of a park pond with a toy shovel, and piles

the sand he has dug in a circle around the hole. When with his cupped hands he tosses the water out of the hole he has made, his little feat of hydraulic engineering is completed—he has "excavated" and "unwatered" an "earth cofferdam."

The big hole seen in the foreground in Fig. 259, showing the work for two of the Black Street bridge piers, is nothing but the child's toy performance, magnified. The operations by which it was built are in essence precisely the same. The dragline excavator at the left, riding on its caterpillar traction (like the tanks in the war), with its seventy-foot boom slanting in front, carrying a steel bucket which lifts a load of three or four tons of earth, represents the toy shovel. The centrifugal pumps, seen in the shadow of the shelter at the right far corner of the excavation, answer to the boy's cupped hands. They draw the water through the two "suction pipes" seen slanting down into the "sump" or hollow at the bottom of the slope, to which the water runs from the pond in the foreground, and indeed from every part of the enclosure, since the levee walls, being of gravelly material, "leak like a sieve" in the more porous places, with the entire river outside to draw on as a reservoir of supply. The maximum water pumped under these conditions, to keep the cofferdam dry, was probably not more than 1,500,000 gallons per day—which would be "some job" for the little boy with his cupped hands.

Such an amount, however, with so large a cofferdam, is all in the day's work. That is what the pumps are for. The pumpage was in fact surprisingly small, the thick gravel wall of the cofferdam quickly silting up with suspended clay from the muddy river water, caulking the leaks to a gratifying degree. A sheet piling cofferdam would also have leaked; and on account of the lack of room, the placing of the pumps within such a cofferdam is always troublesome and often expensive. Sheet piling cofferdams have been used in the Miami for building bridge piers, both at Hamilton and Dayton, and have at times given more trouble due to water than has been experienced in any case on the Black Street work.

The open excavation has a further advantage in permitting a much easier placing of the foundation piles for the pier, after the excavation is completed. With a sheet piling cofferdam, these piles (at Hamilton 20 feet in length), would have had to be swung, "spotted," lowered and driven through the criss-cross of brace timbers within the enclosure. With the earth cofferdam these operations were all done in the open without this interference. Thus at Hamilton as many as 52 piles were swung, "spotted," and driven home, with an average penetration into the gravel of 18 feet, in one ten-hour shift; which is "going some," as any construction worker who is "onto his job" will understand.

Here again the remarkable adaptability of the dragline excavator as a construction tool was demonstrated. It was converted into what was virtually a locomotive crane travelling on caterpillar traction, for handling the pile driver. The bucket was removed. The "leads" of the pile driver—(the vertical timber guides in which, seated on top of the pile, it follows the latter down)—were hung from the end of the dragline boom by a wire cable lashing. (See Fig. 265). By swinging the boom, and by running the machine backward or forward on its caterpillars, these "leads" were "spotted" over the place where the pile was to be driven. The "boom fall"—(the cable running back overhead from the boom end, then down to a hoist engine drum in the house)—was then slacked away, bringing the heavy weight of the boom to bear on the top of the lead frame, pushing it about two feet into the gravel. Firmly supported thus by the boom above and the gravel below, the usual guy ropes employed to steady the leads (and requiring readjustment for each pile driven), were made unnecessary. With 130 to 150 piles to drive for each pier, the saving in this one little item of guy rope adjustment was appreciable. The load cable of the dragline (unhooked from the bucket and passed over a pulley lashed to the boom end), then picked the pile up from the heap, and swung it into place between the leads. The pile driver (hung in the leads by the hoist cable of the dragline), was then lowered onto the top of the pile, and the driving began. Steam for the pile driver was supplied from the dragline boiler through a flexible hose carried up the boom.

Of the objections which may be raised to the method of open excavation used at Hamilton, the most obvious is the much greater quantity of material to be excavated, due to the flat slopes of the enclosing levee wall; but this is largely offset by the much less cost per yard of such work done in the open by the dragline bucket. Probably also, in cases, the material of the river bottom might be unsuitable. High water again, if it comes while the work is on, is likely, especially with silty material, to wash away part of the levee, or perhaps all of it, and deposit it in the bottom of the excavation. At Hamilton the river rose only once so as to flood the cofferdam, carrying away one corner and a side. Fortunately, very little of the material was deposited in the excavation, so that the damage was readily repaired and the cofferdam again pumped out. The upper ten feet of the Hamilton river bed was porous gravel, with a more or less clay-cemented deposit below, the entire excavation averaging about 20 feet below the normal stream bed.

The advantages of the method, as set forth above, may be summarized as follows:

The quicker handling of the bucket due to lack of interference from a network of braces.

The superiority of the dragline over the clamshell bucket as an excavating implement.

The superior efficiency of the caterpillar dragline in handling the pile driver.

The cutting out of pump cost during excavation.

The cutting out of the costs due to sheet piling and bracing.

Considering the simplicity and directness of the method, and in the light of the experience at Hamilton, it would seem to be of a considerably wider application than it has had. Its neglect is perhaps due to the apparent lack of general information among engineers and contractors regarding the merits of the dragline excavator as an allround construction tool. The gospel of the dragline needs to be more widely spread.

An objection to the dragline excavator is its cost. A machine of the size and type used at Hamilton can be bought in fair second-hand condition for from $20,000 to $25,000; or new for about $38,000.

of which in the latter case about $12,000 can be charged to the caterpillar traction. The expense and time required to erect the dragline machine is also somewhat more than in case of the clamshell. The Conservancy forces were fortunate in having the Hamilton machine as a regular item of construction equipment, which only needed to be turned to the new use. The 70-foot boom and 1½-yard bucket of this machine are considered by Mr. Eiffert, the division engineer at Hamilton, to have proved best adapted to the Black Street job. It should be said, however, that a smaller machine, costing two-thirds to three-fourths as much, could probably have done the work at a saving as compared with the usual equipment, though not as cheaply as it was actually done.

It might be also—(although the caterpillar has undoubted advantages)—that a stiffleg derrick on the ordinary skids and rollers and equipped with a dragline bucket—(such a machine as did the embankment building on the Ohio Electric line, described in the Bulletin for December, 1920)—would be worth the consideration of a contractor who lacked a dragline and had a job of pier building in hand.

December Progress on the Work

GERMANTOWN

Outside of placing the slope revetment just below the outlet works, which was finished during the month, the entire work of the month has been dismantling.

The large dragline is entirely dismantled and moved off the job, as is also the steel guy derrick. The dragline is shipped to Piqua; the derrick will go to Franklin. The entire blacksmith shop has been also dismantled and billed to Franklin.

The last meal was served in the mess hall Saturday, January 29.

All buildings that were for sale in camp have been sold at present writing and the several buyers have started to wreck their buildings. The first sale of buildings was held Wednesday, January 26, when ten buildings were sold at public auction. By Saturday, January 29, the entire camp was disposed of.

A. L. Pauls, Division Engineer.

January 31, 1921.

ENGLEWOOD

The only item of actual construction work in progress during the past month was the excavation of the permanent spillway. At this place one large electric dragline has continued digging, passing the excavated material into a levee paralleling the spillway outlet.

Numerous items of plant have been overhauled, including locomotives, pumps, draglines, etc. The large steam dragline has been partially dismantled and the floor girders, which were not sufficiently strong to stand up under the strain of heavy digging, have been reinforced. Car bodies have been repaired, and locomotive wheels turned down to true shape. Advantage was taken of the favorable market to lay in a supply of lumber for spillway forms and general stock. Coal has been coming in as purchases could be made to advantage.

New tracks for handling material in the borrow pit have been laid, as has a return track down the side of the dam from sump No. 4, which will be constructed in the spring.

H. S. R. McCurdy, Division Engineer.

January 15, 1921.

LOCKINGTON

During the past month only a small amount of work has been done, as the job was practically closed down for the winter on December 23. The work has been confined to odds and ends that could be worked upon to good advantage and that should be out of the way by the time work is resumed in the spring.

Repairs were made to various pumps and pipe lines, sections in the dredge pipe lines were sorted according to their future usefulness and relaid where they would give the longest service. Stone that had been taken from the pit and stored in piles about the dam, has been gathered and laid on the slopes of the dam and outlet channel. Some clearing was done below the highway bridge over the outlet channel, thus removing an obstruction to the heavy current along the west bank of Loramie Creek.

Duncan is making good progress on drilling for blasting the hard clay banks of the borrow pit.

Barton M. Jones, Division Engineer.

January 29, 1921.

TAYLORSVILLE

The Lidgerwood dragline was in place and started excavation on the outlet channel on January 10. It has made good progress since. The excavated rock is being taken from the dragline in 12-yard dump cars and dumped on each side of the river in the flat downstream toe of the dam.

The dredge pump shells are being patched and new liners and runners put in. The four 6-inch high pressure pumps are being moved from the west bank of the river to the east bank alongside of the other water pumps and just above the dredge pump.

The warehouse and shop has been moved about 400 feet south from the original location so as to clear the outlet excavation.

Very little has been done on Road 12 this month on account of the frozen condition of the ground.

O. N. Floyd, Division Engineer.

January 27, 1921.

HUFFMAN

The work during the past month has been concentrated on the placing of hydraulic fill in the dam. This work has been carried on without any marked hindrances on account of winter weather.

62,600 cubic yards of material were pumped into the dam during the month of December.

The steam dragline has completed the downstream slope up to elevation 810 (about 25 feet above the valley floor), and is now shaping up the miscellaneous embankment along the outlet works below the dam.

The ditcher is building the upstream slope up to elevation 815. This will be completed the full length of the dam about February 1. This height is sufficient to prevent the embankment from being overtopped by spring floods.

The oversize rock rejected by the revolving screen at the pumping plant is being placed for paving on the upstream slope of the dam as fast as it accumulates.

C. C. Chambers, Division Engineer.

January 22, 1921.

DAYTON

River channel excavation below Stewart Street was started by dragline D-16-15 on January 20, 1921. Hauling material on scows was discontinued January 17, when the last scow load was taken from the channel above Fifth Street bridge. Wrecking of the large spud scow was completed January 20.

D-16-16 is preparing to lower the 24-inch water main above Fifth Street bridge to a position below the finished channel grade. D-16-8 is grading the spoil bank upstream from Wolf Creek. D-16-19 is cleaning up a small quantity of channel excavation on the left bank above Dayton View bridge, placing the material in an adjacent spoil bank.

The Ohio Street retaining wall has been completed and the wall along the Delco-Light property between Keowee Street and the C. H. & D. R. R. tracks is being constructed. No other concrete work is under way.

J. C. McCann is making good progress with the earth work on Mad River.

Price Bros. Company is removing the old stone wall above Keowee Street. Part of the stone is being used as rip rap below the apron of Island Park dam, that work being done under contract with the City of Dayton.

The Finke Engineering Co. has been awarded a contract for constructing the Apple Street sewer culvert.

To date 58,260 cubic yards of sand and gravel have been issued from the gravel plant. The plant is working intermittently because of unfavorable weather.

Previous to January 1, 884,000 cubic yards of channel excavation (Item 9) had been removed and 170,000 cubic yards of levee embankment placed. The total yardage handled in accomplishing that work amounted to 1,924,000 cubic yards. These figures do not include 105,000 cubic yards of excess excavation for scowing canals.

C. A. Bock, Division Engineer.

January 26, 1921.

HAMILTON

The electric dragline D-16-18 has completed the work between the Main Street bridge and the Columbia bridge, with the exception of trimming up a part of the west bank. The tracks and trestle have been removed. The total channel excavation, Item 9, to January 21, 1921, was 842,000 cubic yards.

Piling for false-work have been driven in spans 5, 6 and 7, Black Street bridge. The excavation for the west abutment has been completed and two-thirds of the concrete has been poured.

Price Brothers are continuing their work of driving wood piling for the toe wall of the slope revetment.

Excavation is being continued at the Black-Clawson wall, the driving of sheet piling having been completed.

C. H. Eiffert, Division Engineer.

January 22, 1921.

UPPER RIVER WORK

Troy—The total amount of channel excavation (Item 9) handled under the Jeffrey contract, to date, is 25,000 cubic yards. The dragline D-16-21 has nearly finished the excavation under both spans of the Market Street bridge since the last report, and has also undergone repairs to the propelling machinery during the last two weeks. At present it is starting on its river crossing just above the Market Street bridge.

The C. & C. Hauling Co. is still excavating in the river channel between Market Street and the B. & O. R. R. with both shovels. The gravel part of the excavation is being placed in the Adams Street-Market Street levee and the earth used for top soil on the Market Street spoil banks. Their yardage to date amounts to 70,000 cubic yards (Item 9).

The Finke Engineering Co. has hauled about 2,500 cubic yards of material into the south levee and south approach of Harrison Street during the last month, making their total yardage 27,000 cubic yards.

Piqua—Four cars, carrying parts of the electric dragline for the work at Piqua, have arrived. They are being unloaded at the Western Ohio freight station by the derrick.

C. F. Griffin, Assistant Engineer.

January 25, 1921.

LOWER RIVER WORK

Miamisburg—During the past month Cole Bros. have placed 11,600 cubic yards of material in the east levee and excavated a temporary channel for the tail race of the Ohio Paper Co. A portion of the levee between the Miamisburg Paper Co. and Sycamore Creek has been left temporarily incomplete, owing to lack of material in the adjacent borrow pit. The dragline has just completed the embankment on the south side of Sycamore Creek between Main and Fourth Streets. The next work to be done will be the construction of the levee on the north and south sides of Sycamore Creek between Fourth Street and the Big Four R. R.

The elevation of the C. & D. Traction line over the levee at the north edge of town has just been completed. The maximum raise was six feet at the center line of levee; total length of track raised 800 feet. The material was hauled by the Traction Company from their borrow pit at Carrmonte in 12-yard dump cars, furnished by the District; the cars were loaded by Thos. E. Daniel & Son, a "whirly" shovel being used; the track raising was done by the Traction Company's forces. The work required 13 days to complete.

FIG. 266—FOUNDATION PILE SUPPORTING THIRTY TONS OF PIG IRON

The pile was 8 inches in diameter and 19 feet long, driven 16 feet into the gravel below the bridge pier. This was a small pile, most of those driven being 9 to 14 inches in diameter and averaging 20 feet long, driven 17 to 18 feet into the gravel. 130 to 150 of these piles were used under each pier, driven 3 feet apart each way, the total number depending on the pier width and this on the particular location. To make the test, a 12 by 12-inch timber about 7 feet long was braced on top of the pile, a steel plate being interposed to prevent mashing of the timber. Cross timbers about 6 by 8 inches by about 7 feet long, were then laid across the main timber, and braced to the pile below. The pig iron was placed on the 7 by 7-foot platform thus formed, as shown in the picture. It was hauled by wagon, after being weighed on the Niles Tool Works scales, the loading taking about two days, and the timber platform being supported by jack screws at each corner during this process. The jack screws were then removed, permitting the full weight of the 30 tons to come upon the pile. There was a slight settlement for about three days, amounting in all to ¾ inch, most of this coming early in the test. No further settlement could be observed after the third day, although the total time of the test was continued for a week. Much of the settlement probably occurred in the timber platform, the observations being taken on the top of this, due to difficulty in taking levels on the pile itself underneath the center of so large a platform. This pile, in driving, yielded about ⅓ inch under the last blow of the pile driver hammer, which was more than the average with the piles under the piers as driven. The usual last yielding was an inch to the last 30 to 40 blows. The driving in some cases was carried "to refusal," i. e., till there was no farther measurable yielding. The safety of a street bridge pier, supported on 130 to 150 such piles, in addition to the direct support of the intervening gravel, will be evident.

Franklin—The District's forces, under direction of Mr. Armstrong (formerly construction superintendent at Germantown Dam) are erecting a Bucyrus Class 14 dragline with 60-foot boom on the east bank of the tail race of the American Writing Paper Co. The first work to be done with this machine will be the excavation for the conduits and flood gate structure for this tail race. Work on trestle construction for the east levee will soon be started.

Middletown—Work on the Hydraulic Street wall has been delayed by cold weather. Five hundred twenty-five linear feet of wall was poured this month.

F. G. Blackwell, Assistant Engineer.

January 29, 1921.

Big Four and Erie—There is very little to report for the month's progress on these two railroads. Mr. M. K. Frank has removed the rail and bridges off of the Old Erie line with the exception of about 1 mile of track. The Big Four track will be taken up later by the Big Four Railroad.

The District forces have dismantled the signal plants and are removing all salvageable material.

Ohio Electric Railway—The Railway Company have not completed the bonding of the rails and operation of the line from Huffman will be delayed until this work is completed.

Baltimore & Ohio Railroad—Work completed.

Albert Larsen, Division Engineer.

January 20, 1921.

RIVER AND WEATHER CONDITIONS

River stages were comparatively low throughout December. Although small rises of a foot or two occurred at times, no freshet of appreciable size resulted.

The total rainfall for the month varied from 1.54 inches at Dayton, 1.08 less than normal, to 2.51 inches at Pleasant Hill. The accumulated deficiency at Dayton since January 1 amounted to 3.98 inches.

The local Weather Bureau records show that the mean temperature for the month was 34.0 degrees, or 1.1 degrees greater than normal; that there were 3 clear days, 9 partly cloudy days, 10 cloudy days, and 10 days on which the precipitation amounted to 0.01 of an inch; that the average wind velocity was 14.0 miles per hour, the prevailing direction being from the west; and that the maximum wind velocity for five minutes was 52 miles per hour from the west on the 15th.

Ivan E. Houk, District Forecaster.

January 31, 1921.

Construction Details of Black Street Bridge Piers

The general design of the piers is indicated in the first article in this issue, showing the large margin of safety provided as compared with the Third Street bridge, Dayton, where the partial failure of one pier makes the matter of peculiar present interest. Plan of the construction layout is given in Fig. 267 and of the piers in Fig. 268.

The foundations are on sand and gravel, more or less cemented with clay. Where in one or two cases clay strata were encountered, this material was removed and the foundations carried deeper. The maximum pressure below any pier occurs at one edge of the footing when one adjacent arch is loaded with the maximum live load. At Black Street this pressure is a 3½ tons per square foot. With the entire bridge loaded this reduces to 2½ tons. To provide ample resistance to these pressures 130 to 150 piles are driven under each pier footing, spaced 3 feet each way, the number depending on the width of footing and this in turn on the conditions at the particular pier. The piles are of 20-foot length, driven 18 feet into the sand and gravel and imbedded at the top 2 feet in the concrete of the pier footing. The piers are carried down 12 to 16 feet below the improved channel grade, so that the danger of scour reaching the pier bottom is remote. However, if it occurs, the penetration and spacing of the piles is such that the entire material immediately underlying a pier might be washed away, and the pier would still stand, supported by the piling. This supporting power was determined by actual test, as well as by observations on the piles under the last blows of the pile driver. The test pile, under its load of 30 tons of pig iron, is shown in Fig. 266. The tests and observations together give proof by demonstration that the maximum loads indicated above can be carried by the piles alone without failure. The initiated will understand the ample margin of safety provided.

The pile driver was a No. 3 Vulcan, with 1,800 pound tup, cylinder 8 inches by 30 inches and total weight of 3,800 pounds. Including the leads the total weight was 2½ to 3 tons.

The pier footings vary from 21 feet by 62 feet to 24 feet by 62 feet, according to the conditions encountered. They are reinforced transversely to distribute the heavy loads on the pier shafts evenly over the material below the footings. Bending effects in the shaft (due to unequal loading of the arches on each side), are resisted by light reinforcement near the shaft surfaces, this reinforcement also acting to prevent surface cracks. Horizontal grooves or "rustications" are carried around the surfaces of the shafts at regular intervals, to break up the monotony of appearance, acting in this respect like the courses in stone masonry.

The method of open excavation for the piers has been used throughout, having been found so efficient on pier 3, the first pier excavated, that its use was immediately extended to pier 4, then to pier 2, then to piers 5 and 6. Pier 1 remains to be done. To save moving the pump outfit, the excavation for pier 3 was extended to include pier 4, and later pier 2, all in one large cofferdam. Seepage did not increase with these extensions, due to the silting up of the gravel of the cofferdam by river mud brought down in suspension during a rise in the river. The seepage with all three piers included was indeed scarcely greater than with pier 3 alone. The maximum was about 4,000,000 gallons per day, kept up for about a week, a quantity about equal to ⅔ the daily consumption of the city of Hamilton. The excavation for piers 5 and 6 was also thrown into one (shown in the foreground in Figs. 259 and 265). Into this double excavation the seepage was not measured, but was probably not more than 1,500,000 gallons per day.

After the concreting had been completed for piers 3 and 4 to above water level, a cross dam was thrown between piers 2 and 3. The levees of the cofferdam between piers 3 and 4 were then cut and the river turned through. The dragline, which did this work, was so maneuvered that while finishing it the machine stood on the west levee of the cofferdam and was thus able to proceed at once with the excavation for the next piers, 5 and 6, concrete work on

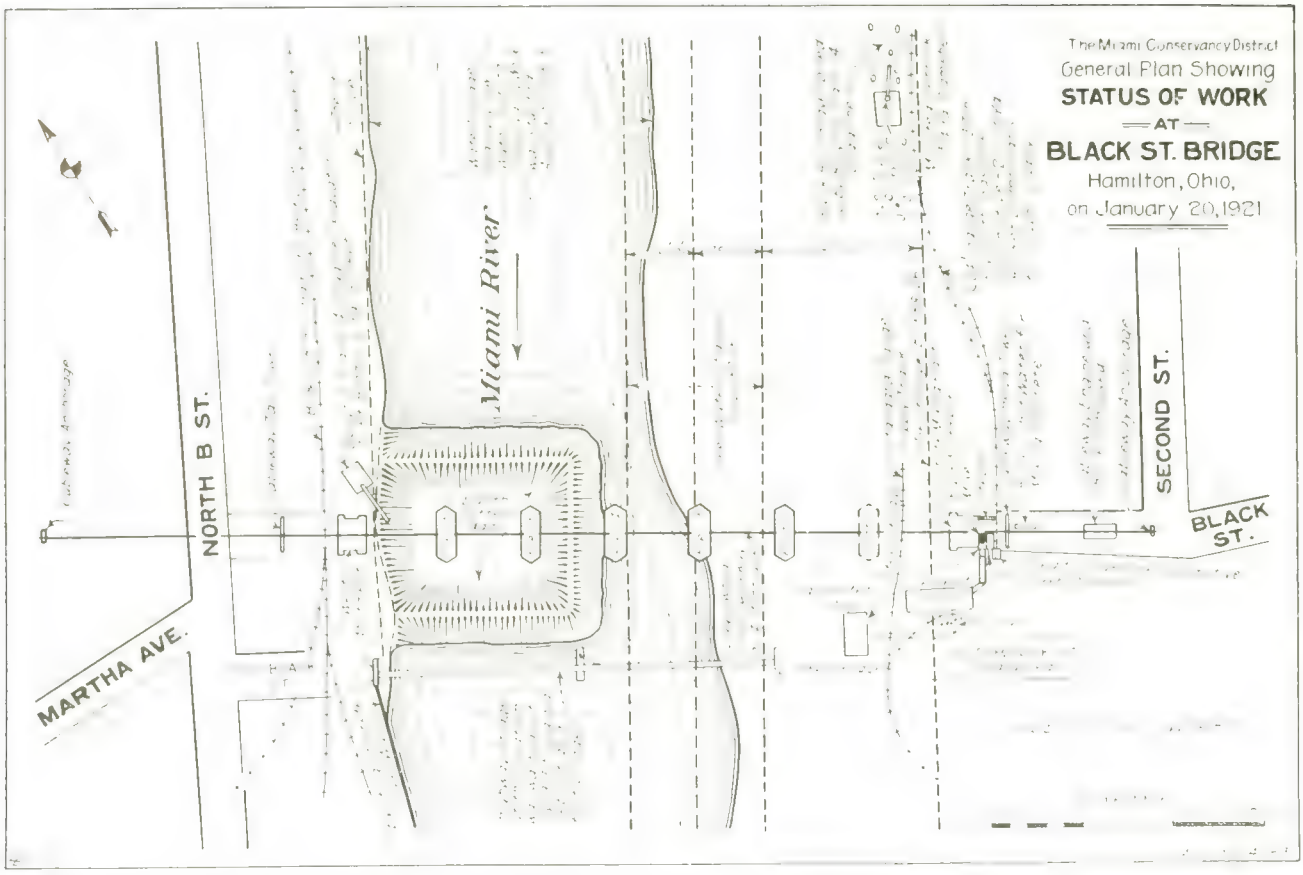

FIG. 267—PLAN SHOWING STATUS OF WORK AT BLACK STREET BRIDGE, HAMILTON, JAN. 20, 1921.

pier 2 proceeding simultaneously. The seepage into the excavation at pier 2, after this had been isolated by the cross dam, was so slight that it was easily handled by a 6-inch pump working part time.

The pumps in the triple excavation for piers 2, 3 and 4 were an 8-inch running constantly, and an 8-inch and a 6-inch running part time. They handled the 4,000,000 gallon maximum without difficulty. The 6-inch pump had an 8-inch suction, one 8-inch had a 10-inch suction, the other a 12-inch. All were electrically driven, with 30, 40 and 50 horse power motors respectively. For piers 5 and 6 two of the above pumps were first used, superceded later by one 12-inch pump with 15-inch suction, driven by a 75 horse power motor. All the pumps were of the centrifugal type. Fig. 264 shows a pump set-up, and also the appearance of the cofferdam. The horizontal discharge pipe was, of course, laid in the open and later covered by the dragline in building the cofferdam. The river is to the right outside the picture.

The pumps were set with a normal lift of 20 feet, increased at times to 22 or 23 feet. This, of course, was in the face of "conventional good form," which is to reduce the lift by setting the pumps as low as possible in the excavation, in order to avoid air leaks and loss of time in priming. The reason for the high setting was to avoid flooding the electric motors by the water rising in the excavation when the electric power shut down, a contingency occurring quite frequently. To meet this condition the pumps were set as high as possible and still lift the water. They worked well at the lift mentioned.

The dragline excavator used was a Class 14 Bucyrus, with 70-foot boom and 1½ yard bucket. It weighed 85 tons with the caterpillars, the latter with its drive mechanism weighing about 29 tons. The weight gave no trouble on the levees, the latter standing up perfectly under the load. The caterpillars were a distinct aid in maneuvering the machine around the cofferdams, and also have an advantage in enabling a quick "getaway" in case of high water. The machine was bought at second hand for $18,000.

The chief risk in using the method of open excavation (see article on page 104), is, of course, that high water may wash away the earth of the cofferdam levees. At Hamilton, on November 22 and 23, this happened. The river rose 9 feet, and flowing mostly in a rather narrow channel between piers 3 and 4, acquired a high velocity. As a result first one corner and then all of the east side of the cofferdam enclosing piers 5 and 6, (the farther side as seen in Fig. 259, which was taken only a day or two before the rise), was washed away, including also about half of the north and south sides. Only the upper ten feet of the levees was affected, the material below remaining in place. Fortunately, the eroded material was not deposited within the cofferdam, so that after the levees had been rebuilt by the dragline and the water pumped out, it required only about two hours' hand work to clean up the excavation. The pump motors and loose material and equipment had been removed by the cableway before the break occurred. The delay due to the accident was just

The concreting layout is shown in Fig. 267, and the mixing plant in Fig. 270. Gravel for the concrete was dug from the river bed by the dragline, and piled in a stock pile on the east bank a little north of the bridge site. An electrically operated stiffleg derrick, running on a 28-foot gage railway, and equipped with a 34-foot boom and a ¾ cubic yard Owens clamshell bucket, loads this material into 1½-yard Western rocker dump cars. These are transported to a storage hopper at the mixing plant by a 3-ton Plymouth gasoline locomotive on a 2-foot gage track. The storage hopper, of 34 cubic yards capacity, feeds the material in turn through chutes into the batch hopper of the mixer on the charging floor. The mixing plant is on the east bridge abutment. The oversize rock, (above 6 inch), is screened out by a gridiron steel screen over the mouth of the storage hopper. The cement is wheeled from the cement house to the charging hopper by hand trucks. The mixer is a one-yard Smith. It discharges directly into the bottom dump bucket, which stands in a pit directly below the cableway. The latter transports the bucket from the mixer to the work, where the concrete discharges into a hopper, whence a chute takes it to the forms.

Tests made on the bank run gravel which is used show that the ratio of sand to gravel is about 1 to 2 at all times. For the mass concrete of the piers and abutments, therefore, no screening is necessary except to reject the oversize mentioned. The gravel is so clean that it requires no washing. For the bridge arches, floors, etc., the gravel will be screened and proportioned as required.

The mix employed in the piers varies with the location. In the footings an approximate 1:3:6 ratio is used, 4 bags of cement being charged into a batch of concrete. The measuring is virtually done in the concrete bucket which transports the material to the forms, enough of the bank run gravel being run into the charging hopper, with the 4 bags of cement, to just fill the bucket after being mixed and discharged. For the stems of the piers 5 bags of cement are employed per bucket; and for the pier tops and for the last 8 or 10 feet of the upstream pier nose, 6 bags are used.

The cableway is a Lidgerwood of 5 tons capacity. The towers are 80 feet high and 800 feet apart, the hoist engines being housed on the east bank, with the 60 H. P. boiler which feeds them. The cables comprise the main suspension cable, the fall line, the button line, and the endless cable which pulls the carriage. No trip line is used, the bucket being dumped by hand. A fuller description of this cableway will be given in a future issue.

Five of the six piers, the east abutment, and about half the west abutment, are completed. Pier one still remains to be built.

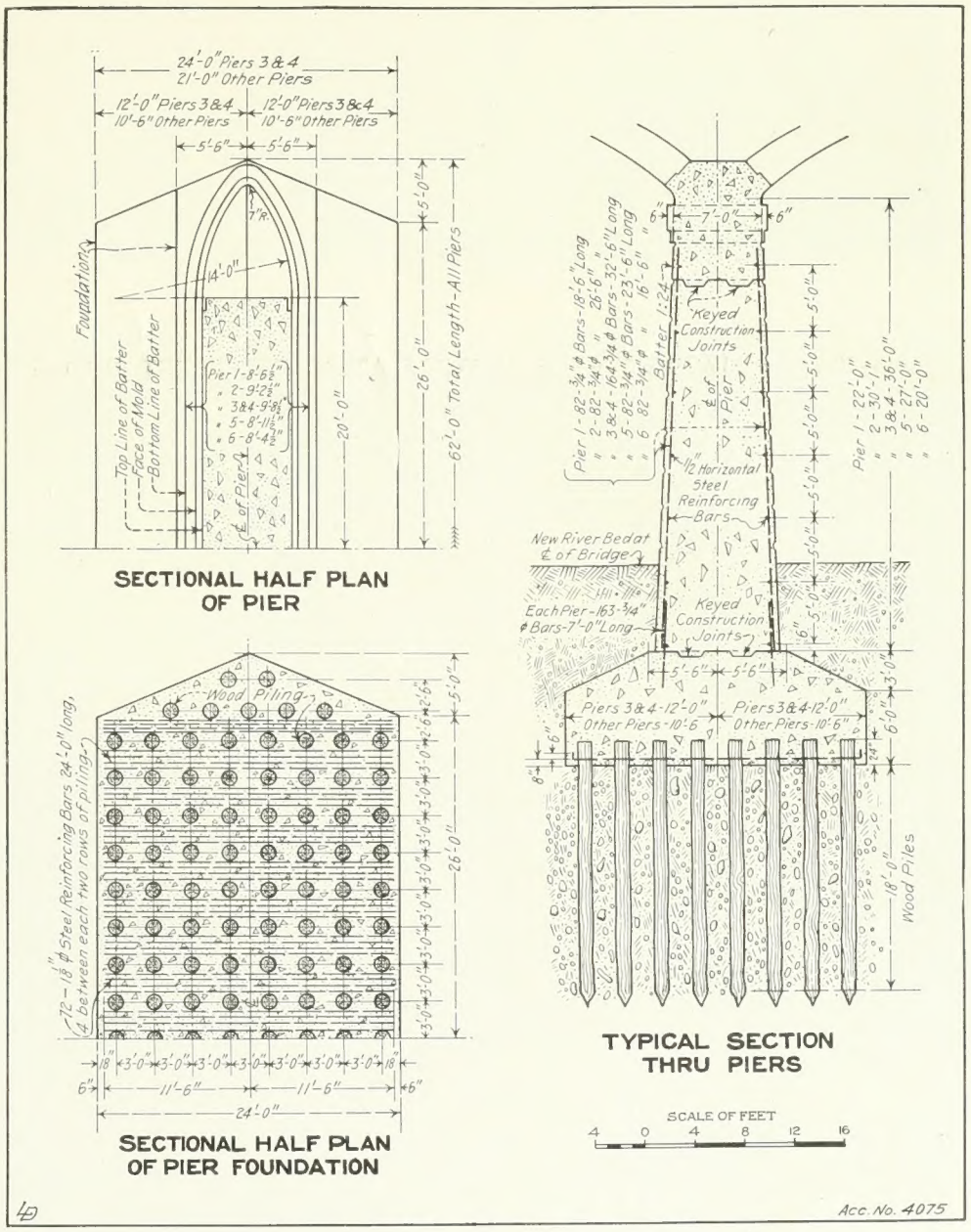

FIG. 268—DETAILS OF BLACK STREET PIERS.

FIG. 269—BLACK STREET BRIDGE UNDER CONSTRUCTION, JANUARY 27, 1921, SEEN FROM THE WEST CABLEWAY TOWER.

This should be compared with Fig. 259, taken from the same tower on November 19, 1920. The excavation seen in that figure, with its enclosing earth cofferdam, has here disappeared, the two nearest piers in this picture occupying the place of the piles and forms (for pier 5), in the foreground of Fig. 259, and of the nearest pool in that figure, (which occupies the site of pier 6). The river here is seen flowing in a wide channel, occupying most of the space, between piers 2 and 6. In Fig. 259 it is almost all flowing between piers 3 and 4. The east cableway tower is seen in the distance on the pier center line. The four cables in the foreground are the steel cables of the cable way, stretched between the east tower and the one from which the picture was taken. The foot bridge at the right was built to replace the old Black Street bridge, the latter being swept away in the 1913 flood.

Germantown Camp Houses Sold

Practically the Entire Camp, Including 22 Houses, 11 Bunkhouses, and 31 Other Buildings, Sold Within Three Days.

The recent completion of the Germantown dam brought the officers of the District, for the first time, "up against" the problem, how to dispose of the houses and other equipment constituting a Conservancy construction camp. These camps were planned to meet not only the unusual conditions incident to the nature and size of the flood prevention project, but the abnormal difficulty of obtaining and keeping an efficient and desirable class of workers under the stress of war. They were made into attractive villages, whose location in every instance but one is in the vicinity of electric and steam lines, and at such near distances from the cities of the valley as to render it possible to make them permanent homes for workers or those in search of a summer home.

The Germantown camp was the one location referred to, not in the immediate vicinity of traction or other rail service. Also, this camp was the first which it was necessary to put on the market, and selling values, for this reason, as well as on account of the unusual industrial circumstances, were pretty much an unknown quantity. What were the houses worth, and how could that worth be got?—were questions no one was quite prepared to answer.

In these circumstances it was decided to put up a limited number of houses—eight was the final number adopted, of various types and sizes—on sale at public auction. If a reasonable number of people could be got together—real candidates for ownership—supply and demand would meet, and the question of worth be settled.

The first job was to get a crowd, and to this end a thorough-going campaign of publicity was undertaken. It was put under the direction of Mr. Hosea Moyer, the District's labor agent and an old advertising man. The work included a newspaper program covering all publications within 25 miles of the Germantown camp; also a poster campaign over the same territory; and space in the Conservancy Bulletin. This advertising "drive" took a week. It was well worked out, and it paid.

The day of the sale, January 26, was cloudy and cold, but the weather cleared at noon, so that a

crowd of 400 to 500 people gathered by the time the auctioneering began. This was a new role for Mr. Moyer, but was excellently carried out, the bidding being brisk till ten houses and six sheds had been disposed of, the sale being so successful that it was continued atfer the original eight buildings advertised had been disposed of.

Prices having thus been set, negotiations were continued during the same afternoon by private sale, till by nightfall the sum realized in this way approached the total by the auction. The private sale continued during the remainder of the week, (the auction being on Wednesday) the demand being maintained until by Saturday noon practically the entire camp had been sold. The last buildings disposed of were sold to Mr. Howard Stine of West Carrollton, fourteen in a job lot. There still remain six buildings which are necessary for workers engaged in a few last bits of cleaning up on the dam, including buildings of the farm on which the camp stands, these buildings, used temporarily as camp houses, thus reverting to their original use. The buildings sold were 22 houses and cottages, 11 bunkhouses, a shop, a clubhouse, a first aid hospital, 2 warehouses, a school house, a garage, a boiler house, and 23 sheds. The plumbing and electric fixtures in the houses, (except the hot water tanks) were included with the buildings.

The unsold houses will be disposed of later in the present season, probably at private sale, after the work above referred to has been completed.

(Continued from Page 99)

PART IV—CALCULATION OF FLOW IN OPEN CHANNELS.

By Ivan E. Houk,
Hydrographer of The Miami Conservancy District.

283 pages, 6″ x 9″, 79 illustrations, 48 tables, paper covers; price 75 cents net, postpaid.

PART V—STORM RAINFALL OF THE EASTERN UNITED STATES.

By the Engineering Staff of The Miami Conservancy District.

310 pages, 6″ x 9″, 114 illustrations, 11 tables and appendix, paper covers; price 75 cents net, postpaid.

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By the Engineering Staff of The Miami Conservancy District.

192 pages, 6″ x 9″, 3 diagrams, paper covers; price 50 cents net, postpaid.

ATLAS OF SELECTED CONTRACT AND INFORMATION DRAWINGS TO ACCOMPANY PART VI.

10 pages of text, 15″ x 11″, 139 plates, paper covers; price $1.50 net, postpaid.

PART VII—HYDRAULICS OF THE MIAMI FLOOD CONTROL PROJECT.

By Sherman M. Woodward,
Consulting Engineer of the District.

343 pages, 6″ x 9″, 126 illustrations, paper covers; price $1.00 net, postpaid.

The order of presentation is arranged to show: (1) the general nature of the Miami Valley flood control problem; (2) a general comparison of the various plans considered and the reasons for the adopted plan; (3) a more detailed description of the adopted plan; (4) a detailed technical discussion of the principles, theories and methods of the hydraulic calculations required.

The sand and gravel were dug from the river bed by the dragline excavator, and piled in a stock pile next the east bank a little north of the bridge site. They were transported to the mixing plant in 1½-yard Western rocker dump cars on a 2-foot gage track, drawn by a 3-ton Plymouth gasoline locomotive, (seen, with two cars in the dumped position, at the top of the picture). The cars dump the material into a 34 cubic yard storage hopper, (seen just below the cars) whence it is again drawn into a batch hopper, (seen just to the right of the mixer) as it is wanted. The cement to mix with it is stored in the house, one end of which is seen at the right, and wheeled to the batch hopper in hand

(Continued below)

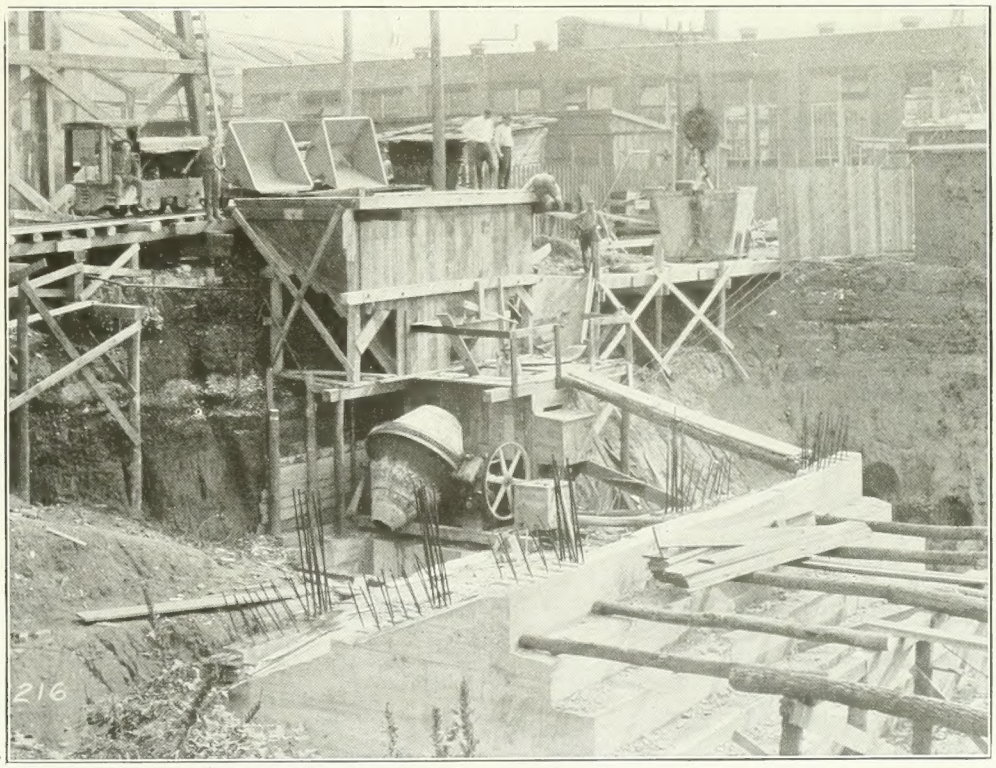

FIG. 270—CONCRETE MIXING PLANT, BLACK STREET BRIDGE. SEPTEMBER 10, 1920.

trucks which dump it down the chute seen just below the man. The mixer, (shown in the dumping position) is a "one-yard Smith." It unloads into a bucket standing in a pit which is seen below the mixer mouth. This pit is directly below the Lidgerwood cableway, (not seen in the picture) on which is a travelling carriage which picks up the bucket (seen hanging to the right of the man) and carries it to a hopper built over the pier which is being "poured." From the hopper, gravity chutes take the concrete to the forms below. The cableway is stretched along the bridge center line between two timber towers erected on shore at either end, and thus serves any part of the bridge construction, handling not only concrete, but forms, steel, pumps, etc.

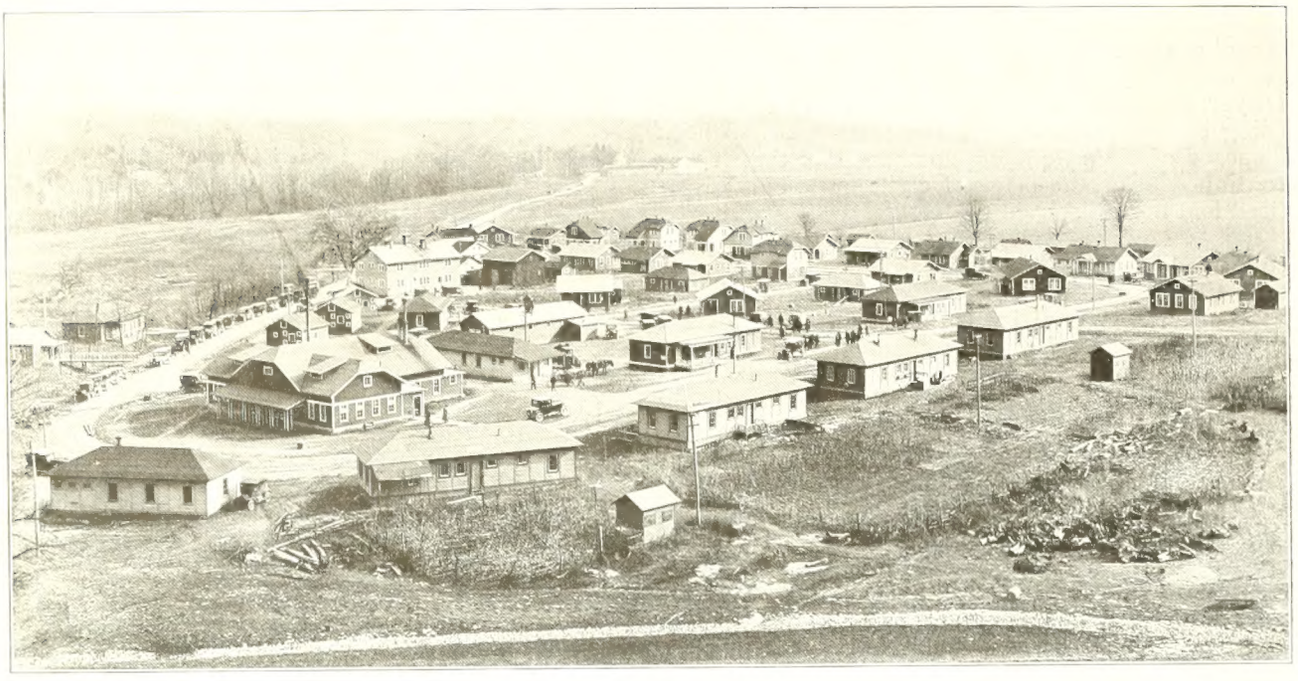

FIG. 271—GERMANTOWN CAMP ON DAY OF AUCTION SALE OF HOUSES, JAN. 26, 1921

The work on the Germantown dam being completed, the camp houses were no longer needed. To determine a proper selling price 8 houses were put up at auction on January 26. Following a week's advertising campaign ten houses were disposed of at this auction, following which the remainder of the camp was disposed of at private sale in the three following days.

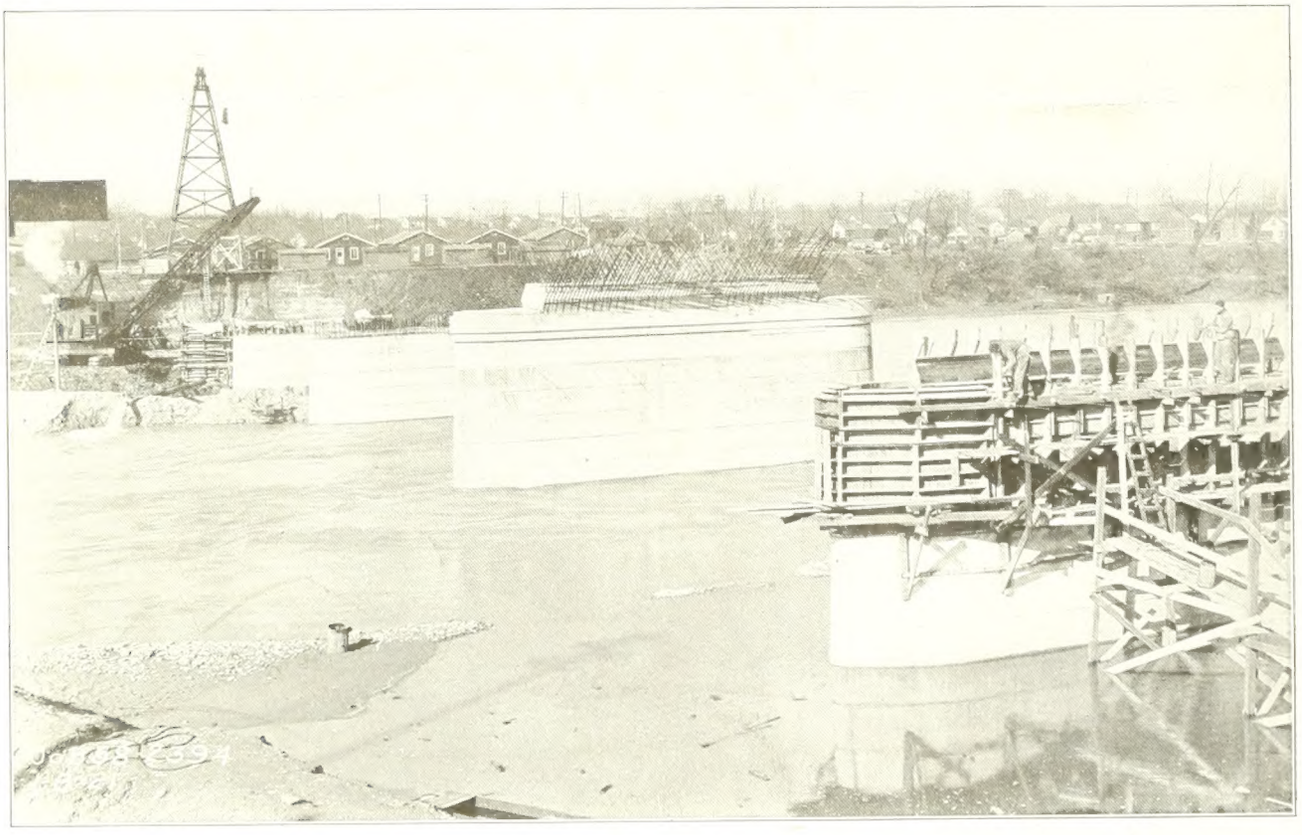

FIG. 272—BLACK STREET BRIDGE PIERS, SEEN FROM FOOTBRIDGE. JANUARY 8, 1921.

This shows piers 2, 3, 4, 5, and 6, in the order named, right to left. It should be compared with Fig. 260. The second pier in the picture (pier 3) has been carried to a little later stage than any of the others, the pier shaft being complete, and the "skewback" surfaces ready to receive the springing of the arches. The bars of reinforcing steel may be seen "sprouting" from these skewback surfaces, ready to be wired inside the arch forms to be built the coming season, to become imbedded later in the concrete of the bridge arches, which they will thus tie with the steel to the concrete of the pier top.